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5 Page 144

Development of antistatic polymer by using high-performance  
salt and by controlling phase structure

- Effective method of allowing olefin polymer  
and TPV to be antistatic -

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1. Introduction

In recent years, as a material substituting rubber,  
various kinds of thermoplastic elastomers (TPV) of dynamic  
crosslinking type have been developed and practically used.

20 Olefin polymers such as polypropylene (PP) and polyethylene  
are widely used because they are inexpensive and applies a  
small load to environment. Uses or products of these  
substances which require antistatic performance have  
increased. Various kinds of antistatic agents including an  
25 incorporating type and a spray type have been proposed. But

these two types of antistatic agents have the following disadvantages: It is necessary to add a large amount of the incorporating-type antistatic agent to the TPV or the olefin polymer such as polypropylene. The effect of the spray-type antistatic agent does not last long. Little effective antistatic agents have been hitherto provided. The object of the present research is to find a system capable of providing the TPV or the olefin polymer having antistatic performance by adding a small amount of the antistatic agent and a high-performance salt in combination to the TPV or the olefin polymer and by controlling the structure of the phase of rubber and the like.

## 2. Experiment

Commercially available antistatic agents A and B, an antistatic agent 1 developed by us, and a compatibilizing agent shown below were added to the following base materials ① and ② shown below by using a double-screw extruder, as described below. After sheets having a thickness of 2mm were formed from the above substances by using an injection molder, the surface resistivity thereof was measured.

### • Base material:

① Commercially available polypropylene (PP) (injection molding grade: MFR=2.9[g/10 minutes] (230°C/load 2.16 kg hour))

② TPV containing EPDM and styrene-based TPE as

its main components

- Commercially available antistatic agent A (incorporating type)

- Commercially available antistatic agent B (incorporating type and containing salt)

- Developed antistatic agent 1 (incorporating type and containing high-performance salt)

- Compatibilizing agent (ester-based copolymer, the addition amount thereof was 10 parts by weight with respect to 100 parts by weight of the polypropylene)

- Surface resistivity: measured by a measuring apparatus in accordance with JIS K6911

Applied voltage: 1 kV,

Measuring condition: 23°C/55% rh.

### 3. Results

1) It was found that the propylene, namely, the sheet composed of the following substances was antistatic. The sheet was composed of the polypropylene and the antistatic agent (1), containing the high-performance salt, which was used in a smaller amount than that of the commercially available antistatic agents A and B. On the other hand, the sheets composed of the propylene and the commercially available antistatic agents A and B respectively were not antistatic.

2) It was found that the propylene, namely, the sheet

composed of the following substances was also antistatic.  
The sheet was composed of the polypropylene, the antistatic  
agent antistatic agent (1), containing the high-performance  
salt, which was used in a smaller amount than that of the  
5 available antistatic agents A and B, and the compatibilizing  
agent consisting of the ester-based copolymer.

3) Regarding the sheet containing the TPV, the  
antistatic agent (1) was localized in the matrix phase  
consisting of a small amount of resin. Thereby the amount  
10 of the antistatic agent (1) added to the TPV was smaller  
than the amount of the antistatic agent (1) added to the  
polypropylene. Particularly the ratio of the phase of the  
crosslinked rubber was increased. Thereby it was possible  
to reduce the addition amount of the antistatic agent (1)  
15 greatly.

Fig.1

- 1: Surface resistivity vs amount of antistatic agent  
2: Applied voltage: 1 kV, Measuring condition: 23°C/55% rh  
20 3: Commercially available antistatic agent A  
4: Commercially available antistatic agent B  
5: Developed antistatic agent 1  
6: Developed antistatic agent 1 + compatibilizing agent  
7: Amount of antistatic agent (part by weight) with respect  
25 to 100 parts by weight of PP (polypropylene)

8: Fig. 1 Dependency of surface resistivity on addition amount of antistatic agent with respect to 100 parts by weight of PP

Fig.2

5 1: Surface resistivity vs amount of antistatic agent

2: Applied voltage: 1 kV, Measuring condition: 23°C/55% rh

3:  $\phi$  (rubber):  $\phi$  (resin)=50:50

4:  $\phi$  (rubber):  $\phi$  (resin)=62:38

5: Amount of antistatic agent (part by weight) with respect  
) 10 to 100 parts by weight of PP (polypropylene)

6: Fig. 2 Dependency of surface resistivity on addition amount of antistatic agent with respect to 100 parts by weight of TPV having different ratios in crosslinked rubber (when developed antistatic agent 1 is used)

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## 2PC13 高性能添加塩と相構造制御を用いたポリマーの帯電防止

### ～ オレフィンポリマー及びTPVの効果的な帯電防止 ～

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#### 1. 緒言

近年、ゴムの代替え材料として、多種の動的架橋型熱可塑性エラストマー(TPV)が開発・実用化されている。また、ポリプロピレン(PP)、ポリエチレン等のオレフィンポリマーも、コストに優れ環境負荷も小さいことから広い分野で用いられている。これらの材料に関して帯電防止性能が必要な用途も増えてきている。一方で、練り混み型・塗布型を含め種々の帯電防止剤が提案されているが、練り混み型は大量に添加する必要がある点、塗布型は効果が永続的でない点から、効果的なものが少ないのが現状である。本研究では、高性能添加塩の併用や、相構造制御の積極的な援用により、より少量の添加で帯電防止を実現出来る系を見出すことを目的とした。

#### 2. 実験

基材：①市販のPP(射出成形グレード、MFR=2.9[g/10min]  
(230℃/荷重 2.16kg 時))

②EPDM とスチレン系 TPE が主成分の TPV

に下記帯電防止剤等を二軸押出機で混入した。射出成型機で2mm厚のシートを作成した後、表面抵抗率等を測定した。

- ・市販品 A(練り混み型帯電防止剤)
- ・市販品 B(練り混み型帯電防止剤、塩含有タイプ)
- ・開発品 1(練り混み型帯電防止剤、高性能添加塩含有)
- ・相容化剤(エステル系共重合体樹脂、添加量 10 重量部(対 PP))

表面抵抗率：JIS K 6911 に準拠した測定機で測定。

印加電圧:1kV, 測定環境:23℃/55%rh.

#### 3. 結果

- 1) 高性能添加塩を併用することにより、市販の代表的な帯電防止剤を用いた場合と比較して、より少量の添加で、PPの帯電防止化を実現出来た。
- 2) エステル系共重合体を相容化剤として併用することにより、より少量で帯電防止化が出来た。
- 3) TPVにおいては、少量の樹脂マトリクス相に帯電防止剤を局在化させることにより、帯電防止剤の添加量を更に削減出来た。特に、架橋ゴム相の比率を高めることにより、大幅に添加量を削減出来た。

発表では成形品での上記以外の特性や、相構造について紹介し、新しい用途等に関して議論したい。

Study for antistatic polymer compound using morphology control and high performance salts

～ An effective antistatic compounding of olefin polymer or thermoplastic vulcanizates ～

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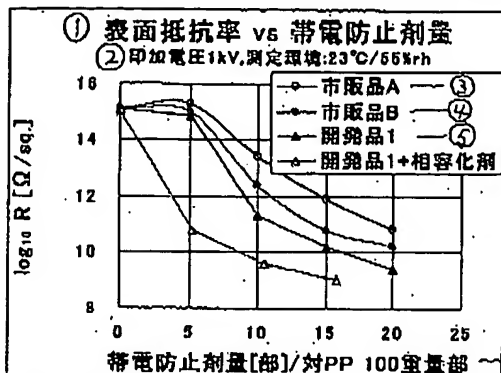


Fig.1 PP に対する表面抵抗率の添加量依存性 — ⑧

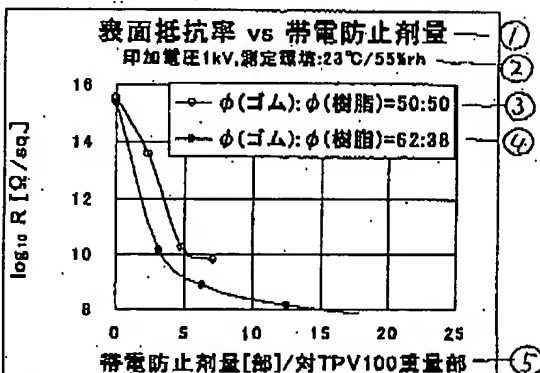


Fig.2 架橋ゴム比率の異なるTPVでの表面抵抗率の添加量依存性(開発品1使用時) — ⑥

(2)A transparency that was used at the publication above  
Method of manufacturing products made of thermoplastic  
elastomer at low cost and allowing them to have high  
function by controlling distribution of antistatic agent

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Impartation of conductivity to thermoplastic elastomer of  
dynamic crosslinking type (TPV)

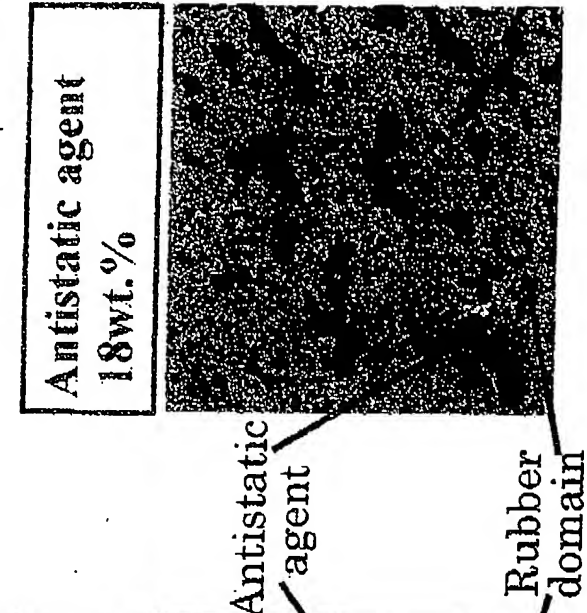
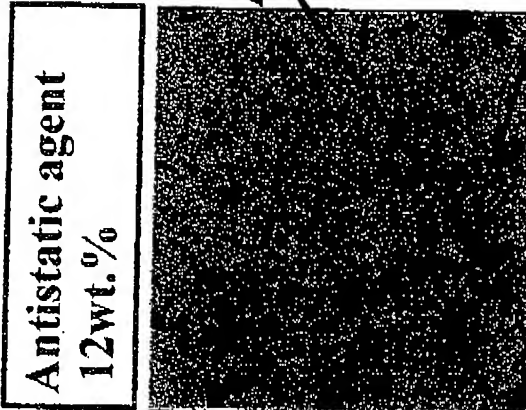
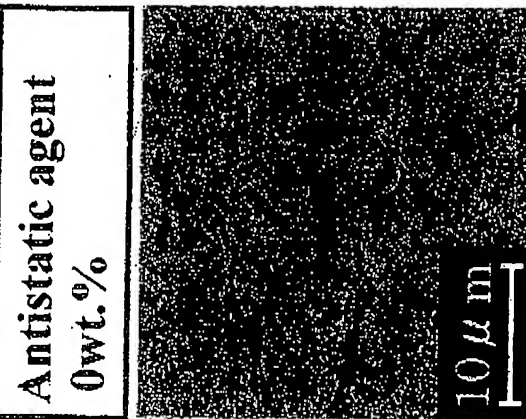
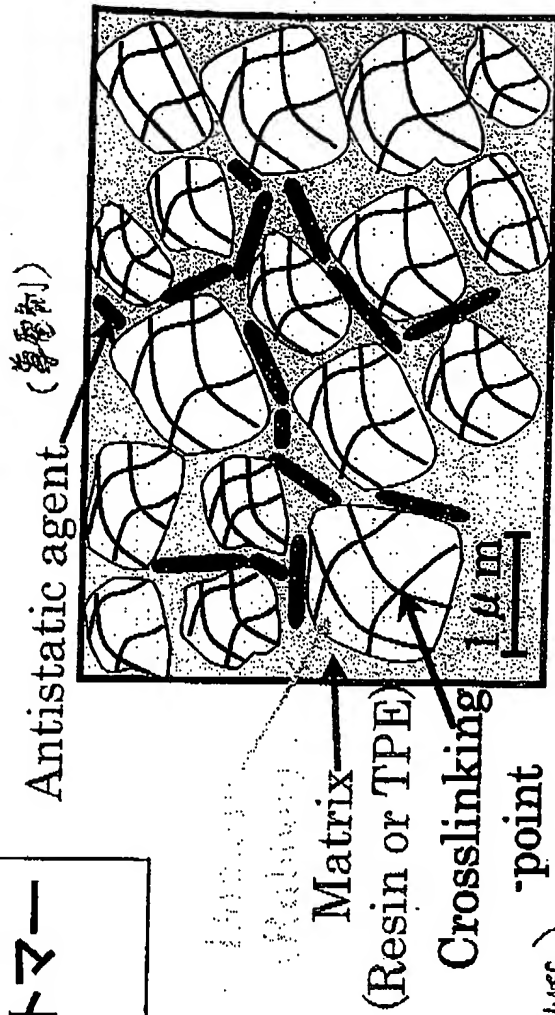
) A small amount of an antistatic agent can be localized  
10 in a resin phase by mixing it with the thermoplastic  
elastomer, after dynamic crosslinking finishes.

# (2) 帯電防止剤の分配制御による低コスト・高機能化

動的架橋型熱可塑性エラストマー  
(TPV)<sup>1)</sup>への導電付与

動的架橋完了後に帯電防止剤を混入すると、少量の帯電防止剤を樹脂相に偏在させることが出来る。

(ゴムが架橋されると硬くなり、帯電防止剤をゴム相に分散させることが出来る。)





「要旨集証明願」

## 証 明 願

平成 15 年 11 月 28 日

社団法人 高 分 子 学 会  
会 長 遠 藤 剛 殿

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第12回ポリマー材料フォーラムにおいて下記の通り文書をもって発表したことを証明願います。

## 記

1. 研究集会の名称 第12回ポリマー材料フォーラム
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3. 期 日 平成 15 年 11 月 10 日
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5. 研究発表題目 高性能添加塩と相構造制御を用いたポリマーの帯電防止  
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6. 研究者名 服部 高幸  
立上義治
7. 文書の種類 第12回ポリマー材料フォーラム要旨集 144ページ (別添)

上記の通り証明します。

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会 長 遠 藤 剛

